

## CLAIMS

What is claimed is:

1. In a directory server, a system capable of interacting with entries  
5 organized in a tree structure, each entry having attributes, the attributes  
comprising real attributes each having a value stored in the entry, the system  
comprising:

a mechanism capable of associating a virtual attribute to an entry subject  
to a virtual attribute condition being verified, the virtual attribute condition being  
10 derived from data located elsewhere in the tree structure; and

a resolving function capable of receiving a first filter expression based on  
a virtual attribute, the resolving function for converting the first filter expression  
into one or more second filter expressions comprising real attributes and  
computed from the first filter expression and from the virtual attribute condition.

15 2. The system of Claim 1, further comprising indexing tables, each  
indexing table related to a real attribute and comprising an ordered list of  
attribute values with corresponding entry identifiers, the indexing tables being  
extendable to those of the real attributes which may be contained in the one or  
20 more second filter expressions.

3. The system of Claim 2, wherein some of the indexing tables are  
cached.

4. The system of Claim 2, further comprising a filter execution function comprising:

a real filter evaluation function capable of receiving a real-based filter expression based on a real attribute, for determining a corresponding set of entries;

a virtual filter evaluation function capable of receiving a virtual-based filter expression based on a virtual attribute, for submitting the virtual-based filter expression to the resolving function as a first filter expression, and for subsequently submitting resulting second filter expressions to the real filter evaluation function; and

a discriminator for determining whether a filter expression is a real-based one or a virtual-based one.

5. The system of Claim 4, wherein the real filter evaluation function is arranged to determine the set of entries from an indexing table for the real attribute, if available.

6. The system of Claim 4, further comprising a filter manager responsive to the receipt of a request comprising a filter expression, the filter manager for calling the filter execution function and evaluating the request in the set of entries determined by the filter execution function.

7. The system of Claim 6, wherein the filter manager has a filter-dividing function capable of splitting an input filter expression into elementary filter expressions.

8. The system of Claim 7, wherein the filter-dividing function is operable to split a filter expression presented as an input of the filter execution function into elementary filter expressions for application to the filter execution function, and the filter execution function is arranged to combine the respective results in accordance with the combination of the elementary filter expressions in the input filter expression.

9. The system of Claim 7, wherein the filter-dividing function is operable to split second filter expressions into elementary second filter expressions for application to the real filter evaluation function, and the filter execution function is arranged to combine the respective results in accordance with the combination of the second elementary filter expressions.

10. The system of Claim 1, wherein the first filter expression comprises an operator intervening between a virtual attribute name and a virtual attribute value.

11. The system of Claim 1, wherein the virtual attribute is a role attribute related to a role entry in the tree structure and wherein the virtual attribute condition comprises a role membership condition, the resolving function being operable for converting a first expression comprising the virtual role attribute into a second filter expression based on the role membership condition.

12. The system of Claim 11, in which a user entry meets the role membership condition if it has a real attribute designating a role identifier attached to the role entry.

13. The system of Claim 12, in which the role entry contains a plurality of roles, wherein the resolving function is operable for repetitively receiving a filter expression comprising the role attribute with a value identifying individual ones of such contained roles.

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14. The system of Claim 11, in which a user entry meets the role membership condition if it meets a role filter condition that is attached to the role entry.

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15. The system of Claim 11, further comprising a filter execution function capable of determining a set of entries from the second filter expression, and of restricting that set of entries to those that verify the virtual attribute condition.

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16. The system of Claim 11, in which the role entry has a scope in the tree structure, wherein the virtual attribute condition comprises a scope condition.

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17. A method of operating a directory server system that interacts with entries organized in a tree structure, each entry having attributes, the attributes comprising real attributes and virtual attributes, each real attribute having a value stored in the entry and each virtual attribute being associated to an entry subject to a virtual attribute condition being verified, the virtual attribute condition being derived from data located elsewhere in the tree structure, the method comprising:

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receiving a first filter expression; and  
if the first filter expression is based on a virtual attribute, converting the first filter expression into one or more second filter expressions comprising real

attributes, the one or more second filter expressions being computed from the first filter expression and from the virtual attribute condition.

18. The method of Claim 17, further comprising:

5 constructing indexing tables, each related to a real attribute and having an ordered list of attribute values with corresponding entry identifiers, the indexing tables being extendable to those of the real attributes which may be contained in the second filter expressions.

10 19. The method of Claim 18, further comprising:

if the first filter expression is based on a real attribute, determining a corresponding set of entries from an indexing table for the real attribute.

20. The method of Claim 17, further comprising:

15 determining whether the first filter expression is based on a virtual attribute or on a real attribute.

21. The method of Claim 17, further comprising:

dividing the first filter expression into elementary first filter expressions;  
20 determining a first set of entries for the elementary first filter expressions;  
and  
combining the first set of entries according to the first filter expression.

22. The method of Claim 17, further comprising:

25 converting the first filter expression into a second filter expression based on real attributes;

dividing the second filter expression into elementary second filter expressions;

determining a second set of entries for the elementary second filter expressions; and

5 combining the second set of entries according to the second filter expression.

23. The method of Claim 17, wherein the virtual attribute is a role attribute related to a role entry in the tree structure and wherein the virtual  
10 attribute condition comprises a role membership condition, the resolving function being operable for converting a first expression comprising the virtual role attribute into a second filter expression based on the role membership condition.

15 24. A computer-usable medium having computer-readable program code embodied therein for causing a directory server system to perform a method of executing a filter function, the method comprising:

receiving a first filter expression; and

if the first filter expression is based on a virtual attribute, converting the  
20 first filter expression into one or more second filter expressions comprising real attributes, the one or more second filter expressions being computed from the first filter expression and from a virtual attribute condition, wherein the virtual attribute is a role attribute related to a role entry in a directory structure and wherein the virtual attribute condition comprises a role membership condition.

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25. The computer-usable medium of Claim 24 wherein the computer-readable program code embodied therein causes the directory server system to perform the method further comprising:

constructing indexing tables, each related to a real attribute and having  
5 an ordered list of attribute values with corresponding entry identifiers, the indexing tables being extendable to those of the real attributes which may be contained in the second filter expressions.

26. The computer-usable medium of Claim 25 wherein the computer-readable program code embodied therein causes the directory server system to perform the method further comprising:

if the first filter expression is based on a real attribute, determining a corresponding set of entries from an indexing table for the real attribute.

27. The computer-usable medium of Claim 24 wherein the computer-readable program code embodied therein causes the directory server system to perform the method further comprising:

determining whether the first filter expression is based on a virtual attribute or on a real attribute.

28. The computer-usable medium of Claim 24 wherein the computer-readable program code embodied therein causes the directory server system to perform the method further comprising:

dividing the first filter expression into elementary first filter expressions;

determining a first set of entries for the elementary first filter expressions;

and

combining the first set of entries according to the first filter expression.

29. The computer-usable medium of Claim 24 wherein the computer-readable program code embodied therein causes the directory server system to perform the method further comprising:

5        converting the first filter expression into a second filter expression based on real attributes;

      dividing the second filter expression into elementary second filter expressions;

      determining a second set of entries for the elementary second filter  
10    expressions; and

      combining the second set of entries according to the second filter expression.